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C-A OPERATIONS PROCEDURES MANUAL

9.6.1 Cryogenic System Review

Text Pages 2 through 4

Attachments

Hand Processed Changes

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Approved: _____ **Signature On File** _____
Collider-Accelerator Department Chairman Date

A. Etkin

9.6.1 Cryogenic System Review

1. Purpose

- 1.1. This procedure describes steps to review and document the safety aspects of cryogenic systems. This procedure also prescribes the required occupational training for cryogenic personnel operating or working near cryogenic systems. It pertains to all cryogenic systems including, for example, those used for refrigerating magnets, or as a source of gas. It also includes cryogenic systems supplying purge gas for detectors where the stored cryogenic liquid inventory is greater than 200 liters.
- 1.2. Large quantities of cryogenic fluids are used by the Collider-Accelerator Department to induce superconductivity in magnets and other test applications. Upon warming, a closed container of cryogenic fluid can become an over pressurized vessel because the vaporized fluid occupies approximately 700 times the volume of the liquid. As with room temperature pressure vessels, leaks or ruptures can occur with the subsequent release of energy. In addition, cryogenic fluids and materials pose hazards from cold exposure, thermal contraction, brittle fracture and oxygen deficient atmosphere. BNL ESH Standards 5.1.0 and 5.2.0 pertain to the design and operation of cryogenic systems. Determination of oxygen deficiency hazard controls is made using the method specified in the BNL Standards Based Management System Subject Area on ODH. Each of these chapters specifies the requirements for dealing with a particular hazard or class of equipment, which may affect the safety of a system.
- 1.3. Definitions
 - 1.3.1. Cryogenic - at a temperature below 123°K [-150°C].
 - 1.3.2. Cryogenic facility - an area where cryogenic fluids and/or materials are produced, used, or stored.
 - 1.3.3. Cryogenic personnel - those engaged in or responsible for the production, use, transport, or storage of cryogenic fluids and/or materials.
 - 1.3.4. Shall - implies a requirement without deviation.
 - 1.3.5. Should - implies discretion can be used.
 - 1.3.6. Engineered System - a cryogenic system for an experimental device containing a refrigeration source (closed cycle refrigerator or bulk storage) which has been designed with the appropriate safety features.

2. Responsibilities

- 2.1. The responsible system manager shall coordinate cryogenic design and review activity with the head of the Cryogenic Systems Group.
- 2.2. The head of the Cryogenic Systems Group shall coordinate cryogenic systems design and review activity for the Collider – Accelerator Department.

- 2.3. The responsible system manager shall request the Cryogenic Safety Committee (CSC), as early as possible in the design stage, to review each cryogenic system meeting the requirements of Standard 5.1.0 or 5.2.0.
- 2.4. The responsible system manager shall provide a system description and a safety analysis to the CSC.
- 2.5. The responsible system manager shall ensure that the analysis, review and approval are completed prior to operation or prior to incorporation of a change in system configuration affecting cryogenic safety, preferably prior to construction of the system.
- 2.6. The CSC shall serve the Collider-Accelerator Department in a consulting capacity on all cryogenic system safety matters.

3. Prerequisites

None.

4. Precautions

None.

5. Procedures

- 5.1. The responsible system manager shall perform a safety analysis in accordance with [C-A-OPM-ATT 9.6.1.a](#). The analysis and review shall be directed to all aspects of the system which could present a hazard to personnel.
 - 5.1.1. The analysis shall demonstrate that the system can be safely brought into operation. It also should demonstrate that safe operation can be maintained. Oxygen Deficiency Hazard (ODH) analysis shall be completed to determine the appropriate ODH class of the facility.
 - 5.1.2. The provisions of ESH Standards 1.4.1, 5.1.0, 5.2.0 and applicable ASME Codes shall be followed for all cryogenic pressure vessels and pressurized systems capable of a contained pressure of 15 psig or greater.
- 5.2. The responsible system manager shall prepare documentation in accordance with C-A-OPM-ATT 9.6.1.a through d as appropriate, to demonstrate to the CSC that aspects of the system which could present a hazard to equipment or personnel have been examined.
- 5.3. The responsible system manager shall prepare a description of the training requirements and the list of personnel requiring the training. This training shall be added to the listed personnel's Job Training Assessment (JTA) by the C-A Training and Procedure Manager.

6. Documentation

- 6.1. Documentation specified in procedure and attachments.

7. References

None.

8. Attachments

- 8.1. [C-A-OPM-ATT 9.6.1.a “Cryogenic Safety Analysis”](#)
- 8.2. [C-A-OPM-ATT 9.6.1.b “Failure Mode And Effects Analysis”](#)
- 8.3. [C-A-OPM-ATT 9.6.1.c “Fault Tree Analysis”](#)
- 8.4. [C-A-OPM-ATT 9.6.1.d “What-Ifs Analysis”](#)